Diabetic Retinopathy Diagnosis Using Multichannel Generative Adversarial Network With Semisupervision

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Abstract

Diabetic retinopathy (DR) is one of the major causes of blindness. It is of great significance to apply deep-learning techniques for DR recognition. However, deep-learning algorithms often depend on large amounts of labeled data, which is expensive and time-consuming to obtain in the medical imaging area. In addition, the DR features are inconspicuous and spread out over high-resolution fundus images. Therefore, it is a big challenge to learn the distribution of such DR features. This article proposes a multichannel-based generative adversarial network (MGAN) with semisupervision to grade DR. The multichannel generative model is developed to generate a series of subfundus images corresponding to the scattering DR features. By minimizing the dependence on labeled data, the proposed semisupervised MGAN can identify the inconspicuous lesion features by using high-resolution fundus images without compression. Experimental results on the public Messidor data set show that the proposed model can grade DR effectively. Note to Practitioners—This article is motivated by the challenging problem due to the inadequacy of labeled data in medical image analysis and the dispersion of efficient features in high-resolution medical images. As for the inadequacy of labeled data in medical image analysis, the reasons mainly include the followings: 1) the high-quality annotation of medical imaging sample depends heavily on scarce medical expertise which is very expensive and 2) comparing with natural issues, it is more difficult to collect medical images because of privacy issues. It is of great significance to apply deep-learning techniques for diabetic retinopathy (DR) recognition. In this article, the multichannel generative adversarial network (GAN) with semisupervision is developed for DR-aided diagnosis. The proposed model can deal with DR classification problem with inadequacy of labeled data in the following ways: 1) the multichannel generative scheme is proposed to generate a series of subfundus images corresponding to the scattering DR features and 2) the proposed multichannel-based GAN (MGAN) model with semisupervision can make full use of both labeled data and unlabeled data. The experimental results demonstrate that the proposed model outperforms the other representative models in terms of accuracy, area under ROC curve (AUC), sensitivity, and specificity.